PROGRESS REPORTS

FROM

EXPERIMENT STATIONS

SEASON 1955-56

TANGANYIKA TERRITORY
LAKE PROVINCE

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TANGANYIKA TERRITORY
LAKE PROVINCE
PROGRESS REPORT FOR THE SEASON 1955-1956

COTTON SEASON.

Planting: Ukiriguru, mid November to mid December 1955.
Lubaga, mid December 1955.
Cultivators, mainly December 1955 to early February 1956.
Picking: April to August.
Legal Uprooting Date: 15th September 1956.
Rainfall for the period 1st October 1955 to 30th June 1956.
Ukiriguru: 34·88 inches.
Lubaga: 28·94 inches.

INTRODUCTION.

BY

J. E. PEAT.

Ukiriguru Station.

Rainfall.—The season had a very good rainfall distribution. At Ukiriguru it was one of the best experienced, with an above average total of 34·88 ins. between 1st October 1955 and 30th June 1956, including 5·8 ins. in April and 4·5 ins. in the first week of May. The December rains were also on the heavy side.

At Lubaga rainfall during the same period was 28·94 ins., with a very reasonable distribution.

Staff.—Mr. and Mrs. M. H. Arnold were on vacation leave from 25th May until 4th October 1956.

Mr. I. S. Mkwawa, Assistant Agricultural Officer, was transferred to Musoma on 6th October; he was relieved by Mr. V. P. Babla, Assistant Field Officer, on 22nd September 1956.

Mr. J. E. Peat attended the E.A.A.F.R.O. Specialist Committee Meetings on Soil Fertility in April 1956, and visited the Coast Province of Kenya in August 1956.

Lake Province Cotton.

The 1955-56 Lake Province crop just exceeded 120,000 bales; thus for the third consecutive season there was a record production. The Assistant Director of Agriculture, Mwanza, reported 218,840 cultivators growing cotton—25% more than in 1955. 336,600 acres were reported planted to cotton, 12% more than in 1955 — 1·54 acres per grower. The value of the seed cotton to the grower was £3,810,604, and the Native Authorities gained £134,142 from their 2 cents per pound cess on first grade cotton. 35,564 tons of surplus cotton seed was sold during the year, worth £656,169.

Though climatically it seemed almost an ideal season for growing cotton, the mean yield per acre for the Province worked out at about the same as for the previous season, 0·36 bales per acre planted, or 144 lb. lint per acre. As will be mentioned later, bollworm loss was very heavy in many areas. A yield of 0·45 bales per acre, or 180 lb. lint—nearly achieved in 1948—should have been possible without this loss; this would have allowed of a Provincial crop of over 150,000 bales. The general standard of timely planting and reasonable cultivation was rather better than in some recent years. The extent of the American bollworm loss is illustrated by Ukiriguru and district plot results discussed in the appropriate sections. In the circumstances, a crop of 120,000 bales is considered very satisfactory. The dressing with Perecot of all the cotton seed for planting must have played a part by reducing blackarm loss.

Again this season, cropping in the marginal fringe areas around the established Lake Province cotton growing areas was unsuccessful, mainly because of pest loss. A start is to be made in the 1956-57 season in attempting to control pest losses in these and other areas by insecticide spraying, based on Urambo and Eastern Province experience. In Tanganyika, insecticide use may be the big step forward to increased cotton growing productivity.

There are reports of considerable timely planting for the 1956-57 season, and 8,020 tons of Perecot treated Uk51 are reported to have been distributed.

Summary of the Main Results.

The general trend of husbandry results at Ukiriguru and Lubaga has been as reported for previous years—responses to cattle manure, direct and residual, to phosphate, direct and residual, and to top-dressed nitrogen, showing substantial interactions with phosphate. Resting crop responses continued much as in previous years.

Recommendations that can now safely be made in these hill sand areas are: to use to the full any cattle manure available, with the knowledge that responses will continue for a considerable number of years. If cattle manure is not fully available, apply phosphate, 100 lb./acre double superphosphate, again in the knowledge that residual responses will persist for a number of years. In addition top-dress with 100 lb./acre sulphate of ammonia at the time of cotton flowering, but this is for the year of application only and must be repeated each year. Any land-resting that is possible is equivalent to a dressing of cattle manure in direct and residual responses.

Apart from the Uk55 multiplication, Uk51 covered the whole Province.

Uk55 grown on Kome Island on first multiplication gave 49 tons of seed for distribution in the 1956-57 season from the two tons supplied from Ukiriguru in October 1955—a multiplication rate of 24·5.

In major trials the yield of Mz561 was 78% of that of Uk51 (93 lb. lint/acre less) at Ukiriguru, 68% (91 lb. less) at Lubaga, and 82% (58 lb. less) in district plots. Some of the strains tested were significantly below the level of Uk51, but only one strain in one trial was this season significantly better.

The cropping habits are discussed of 0/334 and 1/667 (the components of Uk55) compared with Mz561, Uk48 and Uk51. They have larger bolls and higher lint indices. Testing continues on the segregates from these and other top strains for the characters of lint index, percentage seed coat damage, and lint length. The Albar 51 and B_2B_{6m} crossing programmes continue.

The general impression this season has been that the dressing of Uk51 seed with Perecot has kept the blackarm phase of *Xanthomonas malvacearum* in hand in a year in which a bad attack might have been expected.

On Ukiriguru, a strain with known insufficient resistance, in spite of acid treatment of the seed, showed substantial loss from blackarm.

In many areas, including Ukiriguru, there was loss from bacterial bollrot. This was especially bad in the Musoma district. All seed for planting had been treated with Perecot.

The outstanding feature of the season has been the loss of crop in late March and in April from bollworm attack—predominantly American, but in some areas spiny bollworm has also been quite serious. On Ukiriguru American bollworm damage varied from complete destruction to a pernicious nibble.

General Account of the Work for the Season.

BY

J. E. PEAT AND K. J. BROWN.

Husbandry.

Time of Planting.

Each year it becomes more and more evident that one of the biggest contributions to cotton productivity in the Lake Province is timely planting. Allowing for the fact that planting too early results in boll opening in late April-early May, when heavy rains may be expected, planting in late November, through December, is recommended. Land may still be prepared for planting late in October and through November.

TABLE 1.

TIME OF PLANTING.

Yields: Seed cotton lb./acre.

Ukiriguru Time of planting trial		*District observation plots*						
Planting date:		*Earliest time of planting for the yr.*	*Late Dec.*	*Early Dec.*	*Mid Dec.*	*Early January*	*Early January* / *Mid Dec.*	*Mean of 12 district plots*
			Shigala (Nassa)	*Lagata (Ukerewe mainland)*	*Arugongo (Geita shore)*	*Mabuki (Kwimba)*	*Lagana* / *Butulwa (Shinyanga)*	
Early November	814							
Early December	594	Earliest	923	1315	1016	1411	971 / 727	992
Early January	439	Delayed	792	753	1078	522	222 / 448	666
Early February	318	Late	535	583	339	47	82 / 283	348
Sign. Diff. (P=·05)	115							

Table 1 shows comparative yields in a time of planting trial at Ukiriguru this past season. The level of yields is on the low side; probably due to American bollworm damage. In the further section of Table 1 there are yield comparisons from the main, delayed, and late times of planting at district plots. In some plots for various reasons the land preparation was later than is desirable. These were simple comparisons, not replicated, but as there were twelve they provide a reasonable measure of the effects of delayed planting.

Land Resting.

The results following the second cycle of "tumbledown" and planted treatments, in Trial (6), are shown in Table 2. Following this second cycle of three-year rests, in the second year of cropping, seed cotton yields were similar to yields after continuous cropping, where 3 tons compost per acre is applied every fourth year.

In Trial (7) the resting treatments were down for five years; in the fourth year of cropping on the first cycle the cotton portion showed non-significant differences between treatments and control. In the millet portion significant differences still showed following the compost dressing four seasons before and following two of the planted fallows which had been undersown with legumes.

The one-year resting trials were discussed in last year's report. This last season variants in one series were carrying first residual crops, and

TABLE 2.

MANURIAL AND RESTING CROP TRIAL.

Ukiriguru—Hill Sand—Trial (6).

6 blocks (cotton) of 5 plots of 1/27·3 acres. Cropping rotation—3 years fallow and millet: 3 years cotton. Compost applied 27th September 1954 (also in 1948 and 1951). Phosphate applied 27th September 1954 (also in 1948 and 1951). Cotton planted 21st November 1955.

Second year of the second cropping cycle	*Second indicator crop of the second cropping cycle*
	Seed cotton lb./acre
A. Continuous cropping with millet in the resting cycle, cotton in the cropping cycle	
Control	416
Compost—3 tons/acre	692
Double superphosphate—75 lb./acre	608
B. "Tumbledown" fallow	707
Planted fallow	695
Sign. Diff. (P=·05)	157
S.E.	± 53·5

in the second series first indicator crops. Yields were very low and errors were high. The general story from Trials (31) and (36) seems to be that there is minor profit from one year "tumbledown" rests, and some profit in the growing of millet undersown with legumes; the major profit follows a "tumbledown" rest with phosphate added and that profit continues at least for two years.

At Lubaga there were no differential responses in the trials testing various land resting and rotation treatments.

Manuring and Fertilisers.

The classic Trial (8), discussed fully in earlier reports and growing the 12th indicator crop, was under bulrush millet, generally less responsive to nutrient applications than cotton. Considering only the original application variants in the main trial, results were non-significant. For the 1955-56 re-applications all treatment results were significant. As a result of applying sulphate of ammonia at 175 lb./acre compared with the long-standing control, a yield of 312 lb./acre

TABLE 3.

NPD EXPERIMENT.

Ukiriguru—Hill Sand—Trial (9).

Main plots split to give 2 × 3 factorial, testing all combinations of:—

(Main plots)	n_0, n_1	0, 200 lb. sulphate of ammonia/acre.
(Sub plots)	d_0, d_1	0, 6 tons compost/acre.
	p_0, p_1, p_2	0, 75, 150lb. double superphosphate/acre.

6 replications of 12 plots, each 1/69·7 acres. Compost and phosphate applied 15th and 16th September 1953 (also in 1946, 1947 and 1950). Nitrogen applied 14th February 1956. Cotton planted 14th November 1955.

SECOND RESIDUAL YEAR OF THIRD CYCLE—NITROGEN RE-APPLIED.

Mean yields: Seed cotton lb./acre.

	(1)	d	n	nd
p_0	775	1296	999	1477
p_1	1016	1241	1296	1665
p_2	932	1416	1427	1722

Sign. Diff. (P=·05)	
in the same half of the table	183
in different halves	261

Interactions

	NP_2+99	ND−15
S.E.	±45·9	±37·0

seed cotton was raised to a mean of 525 lb. The ash residual plots showed no increase over control this year, but application of sulphate of ammonia to a section of these raised the mean yield to 775 lb.

The results from Trial (6) are given in Table 2. This, as has been mentioned in previous years, is a comparison of manuring and land-resting in three-year cycles. All treatments show yields significantly better than control, the light compost dressing possibly better than the dressing of superphosphate alone, and the fallow treatment giving responses similar to the compost dressing.

The results from Trial (9) are set out in Table 3. This year, growing the third indicator crop in the third cycle of treatment, with sulphate of ammonia applied every year, there were continuing, though not spectacular, phosphate residual responses, and very good cattle manure residual responses—500 lb./acre increase from the straight cattle manure dressing. There were nitrogen responses, with strong nitrogen/phosphate interactions. With a control of 775 lb./acre seed cotton a yield of 1,722 lb./acre was obtained from the highest applications.

There are undoubtedly residual benefits from earlier applications. For example, working on a cash-received basis, the value of the NP increase in seed cotton yield for the three years of the first cropping cycle of Trial (9) was Sh. 725/-. The value in the three years of the second cycle was Sh. 1,081/-. The seed cotton was valued at the same price.

The results from Trial (26) are given in Table 4. These are yields from the first indicator crop in the second treatment cycle. As with Trial (9), based on a three-year cropping programme, with re-applications of phosphate and cattle manure, some residual benefits from the preceding cycles would be expected. The phosphate yields are on the low side; the cattle manure yields around what is normally expected. There are direct nitrogen responses, but, as in other experiments, the interesting responses are the interactions between nitrogen and phosphate. The control of 584 lb. seed cotton/acre is raised to 1,189 lb. with the highest applications.

The results from Trial (38) are set out in Table 5. This trial was designed to get response curves, using three rates of double superphosphate and nought, and three rates of sulphate of ammonia and nought. Last season no worthwhile yield differences were obtained. This 1955-56 season, first residual responses have appeared. With a fairly high level of soil fertility straight nitrogen responses show up; there were no phosphate responses, but, again, satisfactory nitrogen/phosphate interactions.

TABLE 4.

NPD EXPERIMENT.

Ukiriguru—Hill Sand—Trial (26).

5 replications of 2 × 2 factorial, with split plots of 1/69·7 acres giving 4 nitrogen treatments. Compost and phosphate applied November 1955. Sulphate of ammonia applied 16th February 1956 at flowering.

p_0, p_1	0, 150 lb. double superphosphate/acre.
d_0, d_1	0,6 tons compost/acre.
n_0, n_1, n_2, n_3	0, 50, 100, 200 lb. sulphate of ammonia/acre.

Cotton planted 25th November 1955.

FIRST INDICATOR YEAR OF SECOND CYCLE—NITROGEN RE-APPLIED.

Mean yields: Seed cotton lb./acre.

Nitrogen treatments	*First indicator crops from dressings of compost and phosphate*			
	(1)	d	p	pd
n_0	584	1007	704	1063
n_1	788	1277	943	1226
n_2	795	1308	1036	1230
n_3	811	1381	1189	1439

Sign. Diff. (P=·05)

in the same column	165
in different columns	259

Interactions

	N_3P+65	N_3D+10
S.E.	±29·1	±29·1

The general summing up is that there should be the fullest use of cattle manure. Where cattle manure is insufficient, phosphate should be applied and nitrogen top-dressed at the time of flowering in February. A few years ago, following a droughty March, some doubts were expressed whether the use of nitrogen by African growers was advisable, but the results of the last few seasons have been so striking in the profit accruing from the use of nitrogen that progressive growers cannot afford not to use it. Its use is now strongly recommended, where phosphate or cattle manure are also used, in other words, where there is a sufficiency of phosphate and probably other nutrients to make the application worthwhile. There is very worthwhile nitrogen/phosphate interaction. The profit is for the year of application only and there may be occasional years when the profit from application is reduced. (The mean March rainfall over a period of 25 years has been 4·75″; March droughts are unusual.)

TABLE 5.

NP EXPERIMENT.

Ukiriguru—Hill Sand—Trial (38).

4 × 4 factorial with N″P‴, N‴P″ and N‴P‴ interactions partially confounded, testing all combinations of:—

n_0, n_1, n_2, n_3 0, 50, 100, 200 lb. sulphate of ammonia/acre.
p_0, p_1, p_2, p_3 0, 45, 90, 150 lb. double superphosphate/acre.

6 replications in 12 blocks of 8 plots, each 1/69·7 acres. Phosphate applied 21st December 1954. Nitrogen applied 15th February 1956. Cotton planted 22nd November 1955.

FIRST RESIDUAL YEAR OF FIRST CYCLE—NITROGEN RE-APPLIED.

Mean yields: Seed cotton lb./acre.

Nitrogen treatments	*Second indicator crop from dressings of phosphate*			
	p_0	p_1	p_2	p_3
n_0	968	971	1065	1029
n_1	1178	1429	1241	1151
n_2	1204	1258	1344	1500
n_3	1246	1517	1254	1549
Sign. Diff. for all comparisons (P=·05)			183	

Interactions

	N_3P_3+121
S.E.	± 32·7

Ridge Tying.

In the Ukiriguru Trial (16) cotton gave a small but significant increase in yield as a result of tying, an increase to 1,137 lb. seed cotton/acre compared with a non-tied yield of 1,076 lb. Differences in the millet section were not significant.

At Lubaga there was a heavy American bollworm attack in March which distorted most of the experimental results. In the one ridging trial under cotton there were no significant differences between 3 ft. planting on the flat, 3 ft. tie-ridged, and 4 ft. tie-ridged. In the second "ibambasi"* trial, also under cotton, with a high error, the 3 ft. tie-ridged planting gave nearly 50% more than the 3 ft. flat planting. In the sorghum portion of this trial, using Dobbs sorghum, 3 ft. planting on the flat gave a mean of 315 lb./acre, 3 ft. tie-ridged 799 lb., and 4 ft. tie-ridged 873 lb. On the "ibushi"† trials, both for cotton and sorghum, yields were similar with flat planting, 3 ft. ridging, and 5 ft. ridging, but there was a reasonable increase over flat planting where the ridges had been tied.

*Cemented hard pan soil.
†Old lake-bed calcareous loam.

No yield differences showed up in a trial at Ukiriguru, comparing 3 ft., 4 ft., and 5 ft. ridging, tied, with cotton and bulrush millet as the indicator crops; nor in a field scale test—in spite of a season of above average rainfall—did 3 ft. ridging break as was feared.

Cotton Breeding.

Of the three cotton breeding programmes two are concerned with breeding for resistance to bacterial blight. These are discussed in the bacterial blight section.

With the exception of the multiplication of Uk55 in Kome Island, the whole of the Province was under Uk51 in the 1955-56 season. For the 1956-57 season 450 tons of Uk51 have been sent to the Coast Province, Kenya, and 220 tons to Nyanza Province. Uk51 is also grown in parts of Tanga Province in Tanganyika. On Kome Island two tons of seed of Uk55 were planted. There was a multiplication rate of 24·5 times; 49 tons of Uk55 are available for planting in the 1956-57 season.

Uk51 lint is commented upon as inherently satisfactory by spinners using it—apart from some unsatisfactory admixture in seed cotton and some extraneous matter in baled lint. There is a growing understanding of the variations in quality that occur between the better Lake shore areas and some of the poorer inland areas.

In the Ukiriguru main strain trial, yields were up to 1,350 lb. seed cotton/acre. There was American bollworm loss in this trial. Mz561 yielded in lint 78% of the yield of the control, Uk51. There was no yield difference between Uk51 from seed continuously grown at Ukiriguru, and Uk51 grown from commercial seed stocks. Uk51 in this trial ginned 1·3% higher than Mz561. It would appear that Uk55 will have a slightly higher ginning percentage and a higher lint index than Uk51. Some of the strains in the trial were significantly down on Uk51, but this year none was superior. Uk55, 0/328, 0/334 and 1/667 were all around the control yield level, but with higher boll weights and higher lint indices. This question of boll size relative to bollworm damage requires thought.

In the Lubaga strain trial Mz561 yielded lint at 68% of the Uk51 level. The mean of the 12 district plots showed Mz561 yielding, in lint, 82% of the Uk51 level; again there were no significant differences between Uk51 seed multiplied at Ukiriguru, and Uk51 from commercial seed stocks.

Taking the district plots as a whole the increased ginning percentage of Uk51 compared with Mz561 was only 0·5%.

From some study of the cropping habits of Mz561, the earlier issues, and 8/290 segregates, it would seem that the early cropping is not very different. It is around early June that 8/290 and the daughter strains start yielding substantially more in picking. In 1955, for example,

0/328, in a picking in the third week in June, yielded at the rate of 540 lb. seed cotton/acre compared with 240 lb. for Mz561. The other daughter strains from the 8/290 family behaved in a very similar fashion. Uk51 approximates more to the 8/290 style of cropping than do the earlier issues. This heavier cropping later in the season is part of the explanation of the higher yields; but there is always a greater possibility of insect and disease damage to the later produced crop.

There will be more intensive study of the variations in cropping. On a station such as Ukiriguru it has not always been possible to time the picking intervals exactly the same from year to year, but to serve this study a more precise picking programme will in future have to be arranged.

This last season, when the crop (reduced by American bollworm attack) was picked in four pickings, the general cropping behaviour has been similar to the cropping of 1955.

A most interesting result showed at Ukiriguru. A fertiliser trial, planted on 22nd November, first residual for phosphate rates, nitrogen re-applied, had six replications. The land was in good heart and growth was uniform. Two replications were planted to the strain 8/290, and two to the daughter strain 0/328. Two replications were planted to a strain 0/457, ex 7/367 ex originally Lubaga 4/112, a good yielding representative of this family in most years; but in some earlier years 7/367 was suspected as not having much resistance to blackarm, whereas the view is growing that the 8/920 family has above average resistance. All seed had been acid-treated, making it equivalent to seed dressed with bactericide.

The extent of blackarm on the 0/457 replicates compared with the 8/290 and 0/328 replicates was striking through the season. The final yield results were as follows:—

Yields lb. seed cotton/acre.

			Adjacent replications		
	8/290	*0/328*	*0/328*	*0/457*	*0/457*
Mean yields all treatments	1332	1392	1385	920	1005
Mean yields of controls (no phosphate or nitrogen)	1065	1161	1037	645	679
Mean yields highest applications of phosphate and nitrogen ...	1816	1799	1782	1054	1032
% Grade C	16%	16%			22%

Why there should have been such a heavy attack under these particular conditions, to a partially susceptible strain, using acid-treated seed, when the Province as a whole suffered comparatively little, is not understood.

Single plant selections had been taken in 1955 in some of the best Ukiriguru lots, more especially daughter strains of 8/290; further selections were taken in 1956. Little habit variation can be seen in the field. Selections all had reasonable cropping habit and generally good leaf hair. In multiplication this last season, discarding was done in the 1955 selections for insufficient leaf hair, and they were all grouped for lint index, seed weight, ginning percentage, percentage seed coat damage, and lint length. There were, as has been recorded in other years and in other territories, considerable variations in these characters from area to area and through the cropping season. As an example, between two pickings a month apart, in 0/334, there was a difference in boll weight of 10%. The same strain grown under different conditions in various district plots showed ginning percentage variations of 31·6% to 36·6%, lint index differences of 4·2 to 5·5, seed weight differences of 8·7 to 10·4 grammes per 100 seeds, and seed coat damage percentage differences of 12% to 39%. There were variations, on Ukiriguru itself, between early and late pickings and cotton grown widely spaced on good land and commercially spaced on poor land.

Comparing the records made in 1955 on the single plants, and the records on the progenies in 1956, it may be said that "high field" for any particular character tends to be "high field" in the succeeding year. Similarly, "low field" in any character tends to be "low field" in the succeeding year, but the mass of material in the middle groupings in the second year may go either way. The 1955 selections are now in trials for the 1956-57 season, and the 1956 selections are in simple replicated layouts as well as in small multiplication bulks. The idea is that the bulks will supply multiplication material for trials and bulking in 1957-58. The simple replication will allow more accurate laboratory testing—without any thought of yield comparisons at this stage from such replication.

In seed grown at Ukiriguru, Mz561 showed 14% of naked seeds, Uk48 3%, Uk51 (both from Ukiriguru grown stocks and ex commercial stocks) nil, and Uk55, nil.

Diseases.

BY

M. H. ARNOLD.

Bacterial Blight (*Xanthomonas malvacearum*).

General.—The most striking feature of the disease this season has been the widespread occurrence of serious bacterial bollrot. In the three previous seasons bacterial bollrot has not, in general, caused severe losses: in most areas, although the incidence has been high, the damage done has appeared slight, lesions being typically restricted to the base of the boll and causing staining of the locule tips only. This season, however, bacterial bollrot has caused widespread loss of bolls and damage to lint; large water-soaked lesions on boll walls have been of common occurrence in addition to lesions spreading from the base of the boll.

Seed treatment seems to offer little protection against this phase of the disease and it would appear that complete control will be achieved only by breeding for resistance. Even if seed borne infection could be reduced to negligible proportions by more efficient seed disinfection, there is still the problem of trash infection, against which it would be very difficult to effect control measures in the Province at large.

Hybrids Resistant to Bacterial Blight.—The importance of bacterial bollrot this season has served to focus attention on breeding for resistance to this phase of the disease. An easy and effective technique for large scale boll inoculation is badly needed, however, and tests on new techniques are being carried out in collaboration with Mr. Logan of Namulonge.

In the Albar 51 programme, backcrossing was discontinued at the end of last season when fourth backcrosses had been made with the best existing Ukiriguru strains. Selections from these crosses, together with selections made at earlier generations, are now being tested. Of 52 lines included in yield trials this season, the majority did not differ significantly from Uk51 whilst three yielded over 20% higher (sig. at $P = \cdot 05$) and one over 30% higher (sig. $P = \cdot 01$). These latter were all derivatives of first backcrosses and closely related to similar lines noted as high yielding in the previous season's trials.

Fifteen single plant progenies and Uk51 were grown in replicated plots measuring 5 ft. × 7 ft. 6 ins., giving 10 stands per plot at normal spacing. The layout employed was a 4×4 balanced lattice square (5 replications). The mean yield of seed cotton harvested was 1,125 lb./acre with a coefficient of variation of 22%; there were fertility irregularities in the trial and losses due to *Lygus* and American

bollworm attack. Lint and seed characters of the selections included in this trial have not yet been studied. It is hoped that in future seasons information from such replicated progeny rows may be utilized to give a worthwhile assessment of yield in the first year after selection.

Although little is at present known about the status of the Albar 51 hybrids with regard to their resistance to bollrot, observations from natural infection indicate differences in the degree of boll resistance between individual lines. Hence it may be possible to build up resistance by selection in this material.

The crossing programme with BAR 14/38 (B_2B_{cm}) was continued, first backcross plants being grown "in season" and second backcross plants "out of season" under irrigation. Amongst the latter were some plants with high jassid resistance and a marked improvement in plant habit. These have been further backcrossed to the best Ukiriguru strains and some have also been selfed. Immunity to stem and leaf attack appears to have been retained by inoculation and rigorous selection. In the coming season as much of this material as possible will be boll-inoculated and, if practicable, breeding continued only from plants which show immunity to all phases of the disease.

TABLE 6.

STEM INOCULATION TRIAL.

Percentage distribution of plants after grading for reaction to stem inoculation.

Variety	*Reaction grade*					
	0	1	2	3	4	5
Albar 49	62·2	35·4	2·2	0·2	0	0
8/290	12·7	48·8	28·6	8·5	0·8	0·6
4/53	0·5	1·4	16·6	56·5	17·8	7·2

Key to grading:—

0	Complete callus; no infection.
1	Incomplete callus and/or trace of infection.
2	Fair callus; definite lesion.
3	Slight callus; spreading lesion.
4	No callus; severe spreading lesion.
5	No callus; main axis and growing point killed.

Design: Randomized blocks (16 replications).

Spacing: 2 rows per 5 ft. ridge at 18 ins. within the row, thinned to 2 plants per hole.

Planted: 15.12.55.

Inoculated: 11.2.56.

Scored: 17/23.4.56 (average number of plants scored per variety=479).

Resistance in Strains of Local Origin.—Observations in past seasons in non-replicated plots have indicated differences in the degree of susceptibility to stem inoculation between strains of local origin. 8/290, from which the present highest yielding Ukiriguru strains have been selected, has consistently shown some resistant plants, whilst 4/53 has been noted for its high susceptibility.

In a replicated test this season, these two strains were compared with Albar 49 for their reaction to stem inoculation. The results, which are summarized below, reveal that 4/53 is almost completely susceptible whereas in 8/290 some 60% of the plants showed a high degree of stem resistance.

When tested at Shambat in 1947 by Hutchinson, using a leaf-spray inoculation technique, 4/53 was found to lack B_2, whilst this gene was present in the parental stocks from which 8/290 was subsequently selected. Wickens and Logan conclude, from tests made on other strains at Namulonge, that B_2 confers virtually no stem resistance in *hirsutum* as indicated by the needle prick technique. Though conditions in the Lake Province are different from those at Namulonge, and it may be that response to needle prick inoculation does not always follow the same pattern in both areas, the difference between 4/53 and 8/290 is so marked as to suggest that genetic factors other than B_2 may be involved.

It is hoped that more local strains may be tested in the coming season with a view to elucidating to what extent there has been selection for bacterial blight resistance during the course of the original breeding programme.

Seed Treatment.—In view of the better results consistently obtained from mercurial seed dressings as compared with copper formulations, attention has been given to the possibility of using mercurials on a large scale in the Province. The main objection to their use is the risk of poisoning, both to the labourers who operate the seed-treating machines and as a result of the misuse of treated seed. It was felt that a seed dressing which imparted a distinctive colour to the seed would help to alleviate the latter risk. To this end, several manufacturers have supplied modified formulations of their seed dressings, which incorporate additional quantities of dyes. Some of these, when applied at the normal rate of 1:300 w/w, impart an adequate colour to the seed, and tests of primary infection made on 21-28 day old seedlings showed that the addition of dyes had made no difference to the effectiveness of the dressings.

The large-scale use of mercurials is not envisaged for the immediate future. There must be further investigation into the dangers to which unskilled labour would be exposed in the dusting sheds, before the use of mercurials can be fully supported.

Measurements of yield in both observation plots and replicated trials did not consistently show increases in yield due to seed treatment. In the main trial where untreated seed was compared with Agrosan-treated and Perecot-treated seed in four 3×3 Latin squares, there were spectacular differences in the general appearance of untreated and treated plots during the first three to four months of growth. Scores of seedlings at 21 days after emergence had shown 94·3% with cotyledonary lesions in the untreated plots compared with 13·5% for Perecot-treated and 5·2% for Agrosan-treated.

Most of the early fruiting points in this trial were lost, however, owing to an infestation of *Lygus,* and later there were losses from bacterial bollrot with some loss from American and pink bollworm. Where yields of the order of 800-1,000 lb. seed cotton/acre might reasonably have been expected from the treated plots, the mean yield harvested was 335 lb. of which 70% was Grade "C". (The mean yield for the untreated plots was 306 lb.; the increase of treated over untreated of 29 lb. or approximately 10% was not statistically significant). Such severe losses of bolls are rarely experienced at Ukiriguru. The heavy pest attack is thought to have resulted from a build up of *Lygus* and American bollworm on some eight acres of early planted sorghum which was growing nearby.

Following last season's observations on the importance of lesions at the cotyledonary node, detailed observations were made on samples of 150 sq. ft. in all plots in the trial mentioned above. Immediately upon uprooting, the plants were graded according to the severity of lesions at the cotyledonary node and the fresh-weight of each class measured. Later the numbers of plants and bolls were recorded.

The data which are summarized in Table 7 show that lesions at the cotyledonary node are associated with suppression of plant growth but there is interaction of plant growth with treatment effects. In view of the pest attack, it is not possible to give a conclusive explanation of the increased productivity of the more healthy plants in the untreated plots compared with those in the treated plots. At least part of the increase must have resulted from reduced inter-plant competition consequent upon greater loss of stand and a higher proportion of severely infected plants. There was some indication, however, that plants in the untreated plots lost fewer of their first formed fruiting points from *Lygus* attack. (The differences between the last two columns in Table 7 are attributable, apart from sampling errors, to loss of bolls from all causes subsequent to the time of scoring).

Scores of bacterial bollrot, made at the same time as the other observations, indicated that the incidence of this phase of the disease was not related to seed treatment. There may have been spread of infection from plot to plot and since cotton had been grown on the

same site for two successive seasons, there may have been infection from trash. It is thought, however, that even in the treated plots seed-borne infection could have provided sufficient inoculum for the later build up of bacterial bollrot.

TABLE 7.

SEED TREATMENT TRIAL, NGEREJA III.

Scores of plants from sample plots.

Design: Four 3 × 3 Latin squares. Plot sizes: 0·0367 acres (total); 0·0034 acres (sample); 0·0135 acres (harvested). Spacing: 2 rows per 5 ft. ridge at 18″ within the row, and 2 plants per hole. Planted: 20/21.1.56. Scored: 12/14.5.56. Harvested: 5.7.56 and 24.7.56.

Treatment		*Lesion grade at cotyledonary node*						*Total plants*	*Total bolls*	*Yield, seed cotton lb./acre*	
		0	1	2	3	4	5			*Predicted from boll number*	*Recorded in remainder of trial*
Untreated	P	31	69	164	142	77	85	568			
	W	9·00	8·91	6·37	4·87	1·64	1·12				
	B	7·10	7·09	5·30	3·95	1·35	0·80		2311	580	306
Perecot	P	354	189	121	76	22	41	803			
45	W	5·93	5·35	3·91	3·58	1·18	1·05				
1:300w/w	B	3·93	3·65	2·73	2·25	1·14	0·76		2638	660	330
Agrosan	P	479	192	105	43	9	10	838			
GN5	W	5·38	4·71	3·65	3·09	1·11	0·80				
1:300w/w	B	2·90	2·81	2·46	2·44	1·00	0·60		2308	580	339

Key:

P = No. of plants (totals of 12 samples).
W = Fresh-weight per plant (ozs.).
B = No. of bolls per plant.

Key to lesion grades:

0 = No infection.
1 = Trace of infection.
2 = Definite lesion.
3 = Spreading lesion.
4 = Severe spreading lesion.
5 = Main axis killed, growth continuing by shoot from one or both cotyledonary buds.

Wilt (Fusarium oxysporum f. vasinfectum).

There were sporadic occurrences of wilt in the same areas in Geita District where the disease has been noted in previous seasons. More patches were observed than last season, but it could not be determined whether this was due to spread of the disease or to further discoveries of diseased patches as a result of more extensive searching. The localities of known occurrence of the disease have been sealed off from the seed multiplication area by the Department of Agriculture. Three sites have been chosen for testing imported wilt resistant strains of cotton in the coming season.

Pests.

BY

J. E. PEAT.

American Bollworm.—Very serious loss was caused throughout the Province by American bollworm attack, which was at its height in March and April. There was partial recovery later in some areas.

The loss caused is illustrated by the yields at two of the best district plots, Suguti in Musoma district, and Lagata in Ukerewe mainland, where there had been heavy American bollworm attack on very well grown cotton. The Suguti plot in 1955 gave a mean yield of 2,293 lb. seed cotton/acre. The mean yield this last season was 811 lb. Similarly, at Lagata, the mean yield was 1,949 lb. in 1954 and 1,683 lb. in 1955; this last season a magnificently grown crop yielded 1,166 lb./acre. There had been some recovery but, as a result of the late crop, 37% was Grade "C" compared with 7% in 1955.

On Ukiriguru the "mbuga" (valley bottom) strain trial was free from American bollworm in mid March; by mid April the entire crop had been destroyed; recovery was to all intents and purposes nil. From past experience this style of crop on the "mbuga" could give yields of 1,500-1,800 lb. seed cotton/acre. The belief is that American bollworm populations bred up nearby on early-maturing sorghum, early planted, and that it was a generation from this that completely destroyed the cotton trial. There was loss elsewhere on the station which it was thought could mainly be attributed to plantings of early-maturing sorghum. It may be that other influences are involved. The need for entomological study is very real.

As regards the people's cotton, the theory is that with favourable early rains they planted areas of early maize—more than in most years

—and that it was the breeding-up on this maize which produced in the next generation the populations that later attacked cotton. It is in areas where maize is grown as a main crop that the damage is always greatest. In North Mara, for example, where maize is an important cash crop but where the people very much want to grow cotton also, because of falling maize prices, a fair acreage of cotton grown as a test was almost completely destroyed by American bollworm damage. In contrast to this on an adjacent island in Mara Bay, where only cotton had been planted, the yield was very satisfactory.

Following the successful results of control at Ilonga and Urambo, experiments in the control of American bollworm and other pests by insecticides are to start in 1956-57. The practical administrative problems involved in the widespread use of insecticides amongst African growers are frightening; but the first step is to demonstrate what control can be effected and at what cost.

From Ukiriguru experience it would seem that the breeding up of American bollworm populations and the transfer to cotton comes from crops fairly reasonably adjacent; for example, it is not thought that there is a movement from "mbuga" sorghum to hill cotton—a matter of a mile or more. The arrangements for this season are that the Botanist has priority on the "mbuga" and cotton there, if need be, must be treated with insecticide if American bollworm attack develops. On the hill, cotton has the priority: the Botanist's nursery is to be sprayed, and his hill sorghum, at the far side of the station, is not to be planted until late January. (As a matter of fact, at the time of writing —January—there is a very large population of American bollworms in the sorghum nursery block—more, and later instars, in the heads which have been bagged for breeding work. There may be bird and insect predatory activity on the open heads).

Spiny Bollworm.—Spiny bollworm damage was of only minor importance on Ukiriguru, where the practice is to uproot *Hibiscus* and other malvaceous weeds continuously through the season. In some districts, for example in Musoma, there was considerable damage from spiny bollworms. It is supposed that these are bred up on the considerable populations of *Hibiscus,* probably especially plentiful in a season of well-distributed rains. The suggestion has been made that communities keen on cotton growing should try to slash down these *Hibiscus* hosts throughout the season.

Pink Bollworm.—Pink bollworm was not a serious pest. The appearance of pink bollworm from time to time is a reminder that a rigorous close season is essential. On Ukiriguru itself, at harvesting, pink bollworms were to be found and in some plots reduced the yield

from late-formed bolls; this was probably a carry-over from the out of season breeding programme. In early July in all parts of the station there were pink bollworms in the late bolls.

Stainers.—It was not a bad stainer year, though by late June, on Ukiriguru, there were considerable stainer populations, which reduced the chance of getting worthwhile top crops. In a count in late June, 76% were *D. fasciatus,* 11% *D. nigrofasciatus,* 7% *D. superstitiosus* and 6% *D. cardinalis.*

Lygus.—There was *Lygus* attack in various areas, especially following American bollworm damage. There was *Lygus* damage in the Ukiriguru "mbuga" following the American bollworm attack already described. In Mr. Arnold's seed dressing trial planted in mid-January —intentionally slightly on the late side—there was crippling *Lygus* attack; this is attributed to a movement of *Lygus* from early maturing, early planted, ripening sorghum nearby. The trial cotton must have been highly attractive at the time of this movement. An NPD cotton trial lying between the sorghum and the attacked cotton, early-planted and tough at the time of the *Lygus* movement, escaped all damage, the top plots yielding up to 1,700 lb. seed cotton/acre.

Soil Chemistry.

BY

P. H. LE MARE AND A. M. KABAARA.

Mr. Kabaara spent six months at Namulonge studying methods of soil analysis. He returned to Ukiriguru in September 1956, when equipment for the laboratory arrived.

Investigation of the quantity, position and movement of nitrate in the hill sands at Ukiriguru has been started. Soil samples, down to 66 inches, are being taken at fortnightly intervals throughout the season 1956-57.

A study of the moisture status of the Ukiriguru soils has commenced. The methods developed by Farbrother at Namulonge are being used.

The effect of land resting and organic manures on supply of nutrients in the hill sands is also being studied.

Appendix.

Origin and Special Characteristics of the Main Cotton Strains Mentioned.

Lake Province Local	The commercial cotton in the Province prior to the issue of Mz561—mainly of Uganda Local origin.
Mz561	A straight selection from Local, first multiplied in the 1939-40 season.
7/367	Ex Lubaga L4/112, ex originally Mz457.
Uk51	A seed issue made up of seven strains with jassid resistance, first multiplied in the 1951-52 season.
4/53	A derivative of Mz561 lacking B_2.
0/457	Ex 7/367.
8/290	Ex 6/320, one of the heaviest cropping Ukiriguru strains—Ex 4/35.
0/328 0/331 0/334 1/667	Ex 8/290.
Albar	Nigerian Allen (−A1) blackarm resistant (−bar) selections made at Namulonge. Two series of selections were made independently, Albar 49 in 1949 and Albar 51 in 1951.
BAR 14/38	B_2B_{6m} Sakel ex Shambat.

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